

TOSHIBA Field Effect Transistor Silicon P/N-Channel MOS Type  
(P-Channel/N-Channel Ultra-High-Speed U-MOSIII)

# TPC8406-H

High Efficiency DC/DC Converter Applications

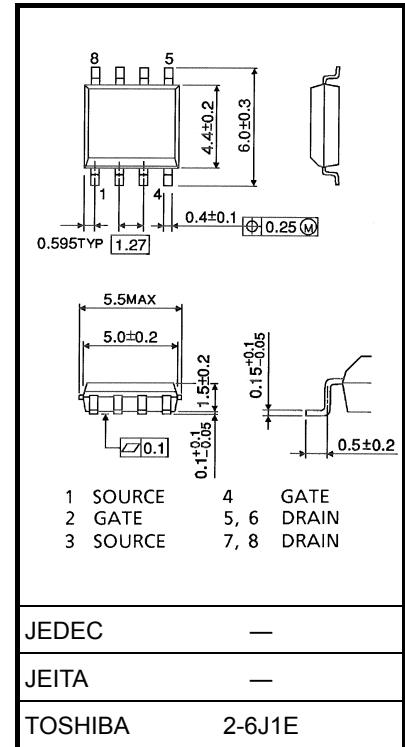
Notebook PC Applications

Portable Equipment Applications

CCFL Inverter Applications

- Small footprint due to a small and thin package
- High speed switching
- Low drain-source ON-resistance: P-Channel  $R_{DS(ON)} = 24 \text{ m}\Omega$  (typ.)  
N-Channel  $R_{DS(ON)} = 22 \text{ m}\Omega$  (typ.)
- Small gate charge: P-Channel  $Q_{SW} = 9.7 \text{ nC}$  (typ.)  
N-Channel  $Q_{SW} = 3.5 \text{ nC}$  (typ.)
- High forward transfer admittance: P-Channel  $|Y_{fs}| = 13 \text{ S}$  (typ.)  
N-Channel  $|Y_{fs}| = 14 \text{ S}$  (typ.)
- Low leakage current: P-Channel  $I_{DSS} = -10 \text{ }\mu\text{A}$  ( $V_{DS} = -40 \text{ V}$ )  
N-Channel  $I_{DSS} = 10 \text{ }\mu\text{A}$  ( $V_{DS} = 40 \text{ V}$ )
- Enhancement mode  
: P-Channel  $V_{th} = -0.8 \text{ to } -2.0 \text{ V}$  ( $V_{DS} = -10 \text{ V}$ ,  $I_D = -1 \text{ mA}$ )  
: N-Channel  $V_{th} = 1.1 \text{ to } 2.3 \text{ V}$  ( $V_{DS} = 10 \text{ V}$ ,  $I_D = 1 \text{ mA}$ )

Unit: mm



Weight: 0.085 g (typ.)

## Absolute Maximum Ratings (Ta = 25°C)

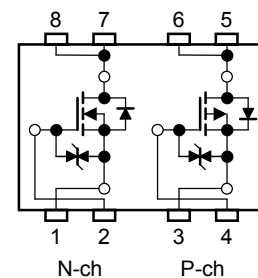
Characteristic	Symbol	Rating		Unit	
		P-Channel	N-Channel		
Drain-source voltage	$V_{DSS}$	-40	40	V	
Drain-gate voltage ( $R_{GS} = 20 \text{ k}\Omega$ )	$V_{DGR}$	-40	40	V	
Gate-source voltage	$V_{GSS}$	$\pm 20$	$\pm 20$	V	
Drain current	DC (Note 1)	$I_D$	-6.5	6.5	A
	Pulse (Note 1)	$I_{DP}$	-26	26	
Drain power dissipation (t = 10s) (Note 2a)	Single-device operation (Note 3a)	$P_{D(1)}$	1.5	1.5	W
	Single-device value at dual operation (Note 3b)	$P_{D(2)}$	1.1	1.1	
Drain power dissipation (t = 10s) (Note 2b)	Single-device operation (Note 3a)	$P_{D(1)}$	0.75	0.75	W
	Single-device value at dual operation (Note 3b)	$P_{D(2)}$	0.45	0.45	
Single-pulse avalanche energy	$E_{AS}$	19 (Note 4a)	19 (Note 4b)	mJ	
Avalanche current	$I_{AR}$	-6.5	6.5	A	
Repetitive avalanche energy Single-device value at operation (Note 2a, 3b, 5)	$E_{AR}$	0.08		mJ	
Channel temperature	$T_{ch}$	150		°C	
Storage temperature range	$T_{stg}$	-55 to 150		°C	

Note: For Notes 1 to 5, refer to the next page.

Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings. Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/Derating Concept and Methods) and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

This transistor is an electrostatic-sensitive device. Handle with care.

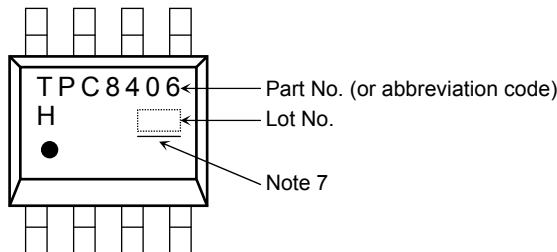
## Circuit Configuration



## Thermal Characteristics

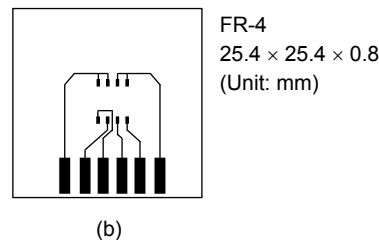
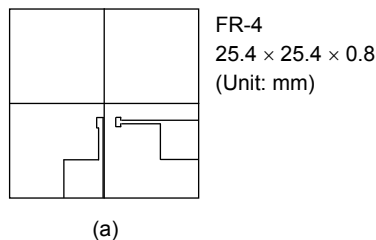
Characteristic		Symbol	Max	Unit
Thermal resistance, channel to ambient (t = 10s) (Note 2a)	Single-device operation (Note 3a)	$R_{th(ch-a)}(1)$	83.3	°C/W
	Single-device value at dual operation (Note 3b)	$R_{th(ch-a)}(2)$	114	
Thermal resistance, channel to ambient (t = 10s) (Note 2b)	Single-device operation (Note 2a)	$R_{th(ch-a)}(1)$	167	
	Single-device value at dual operation (Note 2b)	$R_{th(ch-a)}(2)$	278	

## Marking (Note 6)



Note 1: The channel temperature should not exceed 150°C during use.

Note 2: a) Device mounted on a glass-epoxy board (a)      b) Device mounted on a glass-epoxy board (b)



Note 3: a) The power dissipation and thermal resistance values are shown for a single device (During single-device operation, power is applied to one device only.).

b) The power dissipation and thermal resistance values are shown for a single device (During dual operation, power is evenly applied to both devices.).

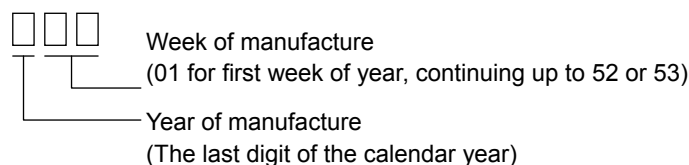
Note 4: a)  $V_{DD} = 24\text{ V}$ ,  $T_{ch} = 25^\circ\text{C}$  (initial),  $L = 0.5\text{ mH}$ ,  $R_G = 25\ \Omega$ ,  $I_{AR} = 6.5\text{ A}$

b)  $V_{DD} = 24\text{ V}$ ,  $T_{ch} = 25^\circ\text{C}$  (initial),  $L = 0.5\text{ mH}$ ,  $R_G = 25\ \Omega$ ,  $I_{AR} = 6.5\text{ A}$

Note 5: Repetitive rating: pulse width limited by maximum channel temperature

Note 6: • on the lower left of the marking indicates Pin 1.

\* Weekly code: (Three digits)



Note 7: A line under a Lot No. identifies the indication of product Labels.

Not underlined:  $[[Pb]]/INCLUDES > MCV$

Underlined:  $[[G]]/RoHS\ COMPATIBLE$  or  $[[G]]/RoHS\ [[Pb]]$

Please contact your TOSHIBA sales representative for details as to environmental matters such as the RoHS compatibility of Product. The RoHS is the Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

## P-Channel Electrical Characteristics (Ta = 25°C)

Characteristic		Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current		$I_{GSS}$	$V_{GS} = \pm 16\text{ V}, V_{DS} = 0\text{ V}$	—	—	$\pm 10$	$\mu\text{A}$
Drain cutoff current		$I_{DSS}$	$V_{DS} = -40\text{ V}, V_{GS} = 0\text{ V}$	—	—	-10	$\mu\text{A}$
Drain-source breakdown voltage		$V_{(BR)DSS}$	$I_D = -10\text{ mA}, V_{GS} = 0\text{ V}$	-40	—	—	V
		$V_{(BR)DSX}$	$I_D = -10\text{ mA}, V_{GS} = 20\text{ V}$	-20	—	—	
Gate threshold voltage		$V_{th}$	$V_{DS} = -10\text{ V}, I_D = -1\text{ mA}$	-0.8	—	-2.0	V
Drain-source ON-resistance		$R_{DS(ON)}$	$V_{GS} = -4.5\text{ V}, I_D = -3.3\text{ A}$	—	29	37	m $\Omega$
			$V_{GS} = -10\text{ V}, I_D = -3.3\text{ A}$	—	24	30	
Forward transfer admittance		$ Y_{fs} $	$V_{DS} = -10\text{ V}, I_D = -3.3\text{ A}$	6.5	13	—	S
Input capacitance		$C_{iss}$	$V_{DS} = -10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	—	1190	—	pF
Reverse transfer capacitance		$C_{rss}$		—	170	—	
Output capacitance		$C_{oss}$		—	250	—	
Switching time	Rise time	$t_r$		—	5	—	ns
	Turn-on time	$t_{on}$		—	12	—	
	Fall time	$t_f$		—	12	—	
	Turn-off time	$t_{off}$		Duty $\leq 1\%$ , $t_w = 10\ \mu\text{s}$	—	43	
Total gate charge (gate-source plus gate-drain)		$Q_g$	$V_{DD} \approx -32\text{ V}, V_{GS} = -10\text{ V}, I_D = -6.5\text{ A}$	—	27	—	nC
			$V_{DD} \approx -32\text{ V}, V_{GS} = -5\text{ V}, I_D = -6.5\text{ A}$	—	15	—	
Gate-source charge 1		$Q_{gs1}$	$V_{DD} \approx -32\text{ V}, V_{GS} = -10\text{ V}, I_D = -6.5\text{ A}$	—	3.2	—	
Gate-drain ("Miller") charge		$Q_{gd}$		—	8.1	—	
Gate switch charge		$Q_{sw}$		—	9.7	—	

## Source-Drain Ratings and Characteristics (Ta = 25°C)

Characteristic		Symbol	Test Condition	Min	Typ.	Max	Unit
Drain reverse current	Pulse (Note 1)	$I_{DRP}$	—	—	—	-26	A
Forward voltage (diode)		$V_{DSF}$	$I_{DR} = -6.5\text{ A}, V_{GS} = 0\text{ V}$	—	—	1.2	V

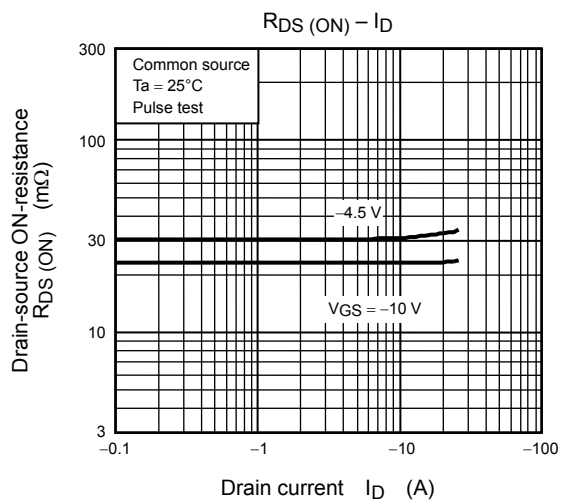
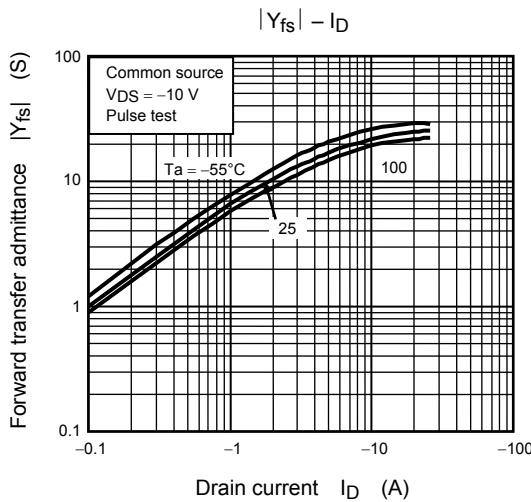
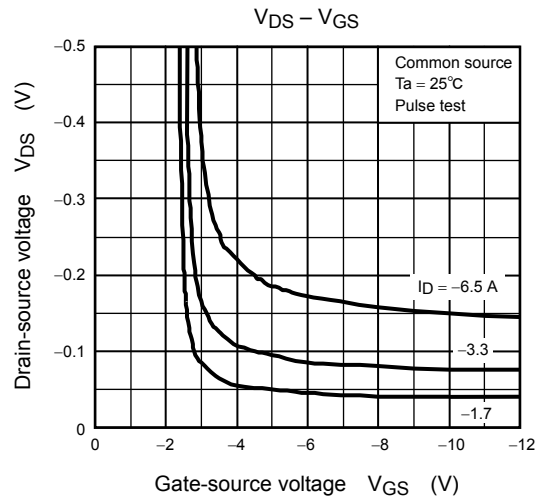
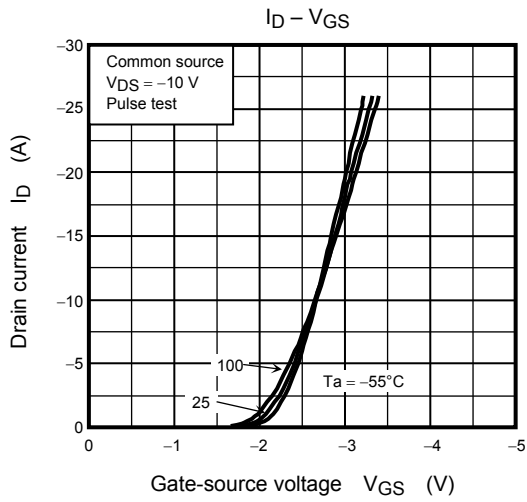
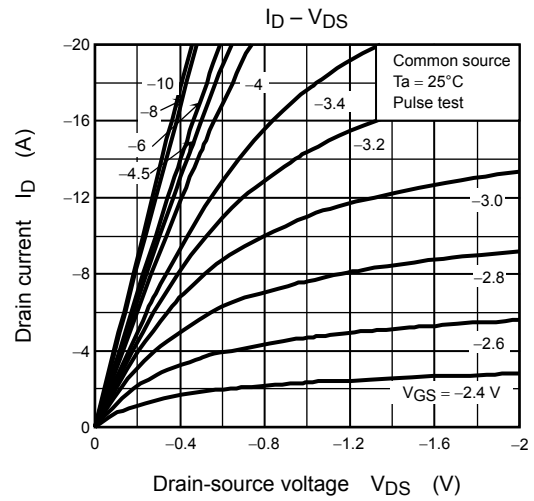
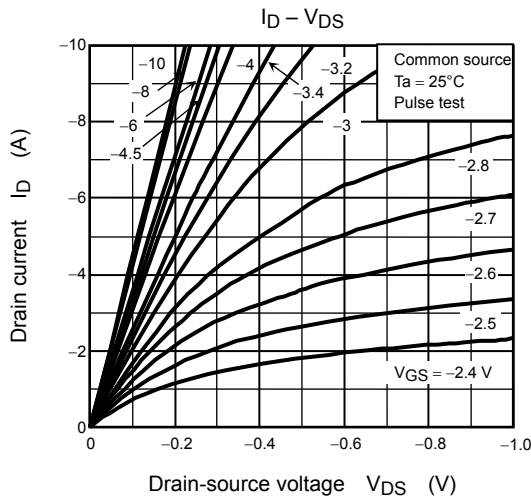
## N-channel Electrical Characteristics (Ta = 25°C)

Characteristic		Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current		$I_{GSS}$	$V_{GS} = \pm 16\text{ V}, V_{DS} = 0\text{ V}$	—	—	$\pm 10$	$\mu\text{A}$
Drain cutoff current		$I_{DSS}$	$V_{DS} = 40\text{ V}, V_{GS} = 0\text{ V}$	—	—	10	$\mu\text{A}$
Drain-source breakdown voltage		$V_{(BR)DSS}$	$I_D = 10\text{ mA}, V_{GS} = 0\text{ V}$	40	—	—	V
		$V_{(BR)DSX}$	$I_D = 10\text{ mA}, V_{GS} = -20\text{ V}$	25	—	—	
Gate threshold voltage		$V_{th}$	$V_{DS} = 10\text{ V}, I_D = 1\text{ mA}$	1.1	—	2.3	V
Drain-source ON-resistance		$R_{DS(ON)}$	$V_{GS} = 4.5\text{ V}, I_D = 3.3\text{ A}$	—	27	35	$\text{m}\Omega$
			$V_{GS} = 10\text{ V}, I_D = 3.3\text{ A}$	—	22	27	
Forward transfer admittance		$ Y_{fs} $	$V_{DS} = 10\text{ V}, I_D = 3.3\text{ A}$	7	14	—	S
Input capacitance		$C_{iss}$	$V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	—	650	—	pF
Reverse transfer capacitance		$C_{rss}$		—	55	—	
Output capacitance		$C_{oss}$		—	240	—	
Switching time	Rise time	$t_r$		—	3	—	ns
	Turn-on time	$t_{on}$		—	9	—	
	Fall time	$t_f$		—	2	—	
	Turn-off time	$t_{off}$		Duty $\leq 1\%$ , $t_w = 10\ \mu\text{s}$	—	18	
Total gate charge (gate-source plus gate-drain)		$Q_g$	$V_{DD} \approx 32\text{ V}, V_{GS} = 10\text{ V}, I_D = 6.5\text{ A}$	—	11	—	nC
			$V_{DD} \approx 32\text{ V}, V_{GS} = 5\text{ V}, I_D = 6.5\text{ A}$	—	6.2	—	
Gate-source charge 1		$Q_{gs1}$	$V_{DD} \approx 32\text{ V}, V_{GS} = 10\text{ V}, I_D = 6.5\text{ A}$	—	2.1	—	
Gate-drain ("Miller") charge		$Q_{gd}$	$V_{DD} \approx 32\text{ V}, V_{GS} = 10\text{ V}, I_D = 6.5\text{ A}$	—	2.7	—	
Gate switch charge		$Q_{sw}$	$V_{DD} \approx 32\text{ V}, V_{GS} = 10\text{ V}, I_D = 6.5\text{ A}$	—	3.5	—	

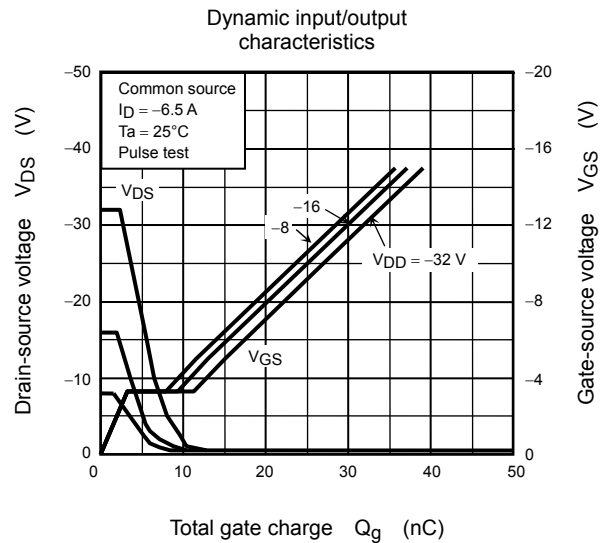
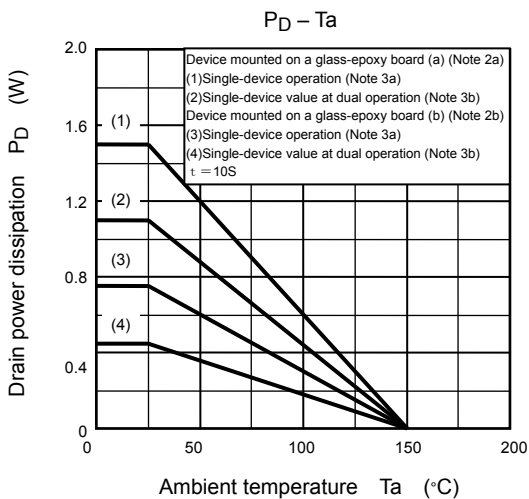
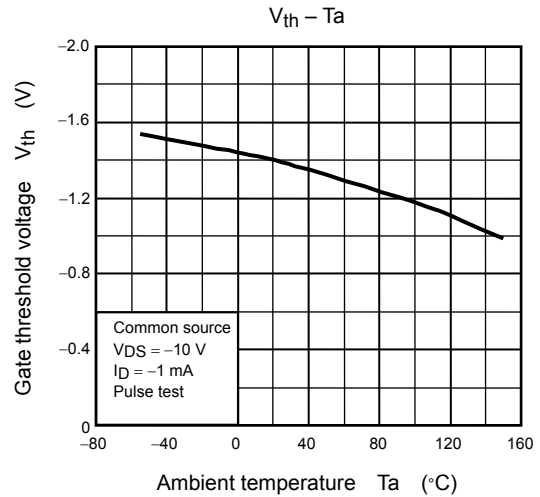
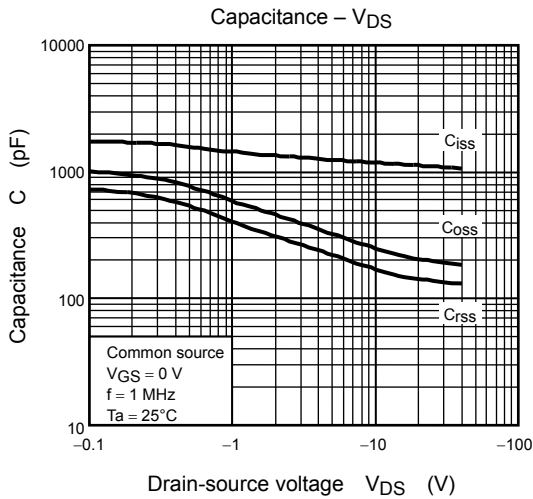
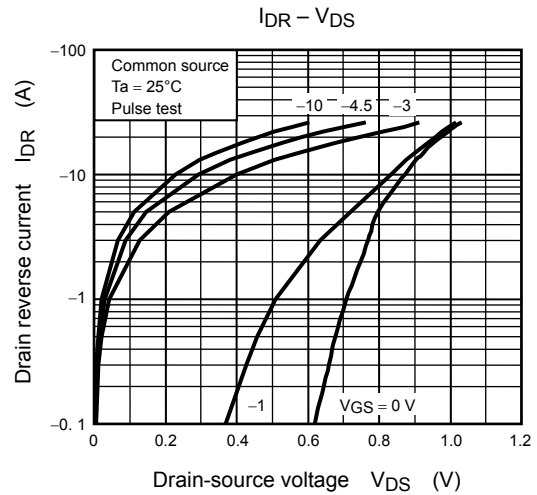
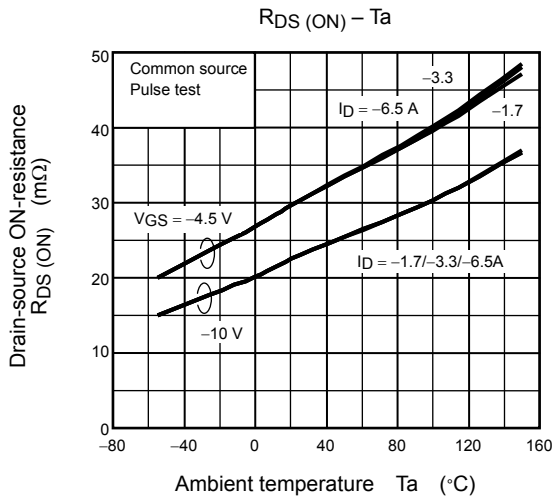
## Source-Drain Ratings and Characteristics (Ta = 25°C)

Characteristic		Symbol	Test Condition	Min	Typ.	Max	Unit
Drain reverse current	Pulse (Note 1)	$I_{DRP}$	—	—	—	26	A
Forward voltage (diode)		$V_{DSF}$	$I_{DR} = 6.5\text{ A}, V_{GS} = 0\text{ V}$	—	—	-1.2	V

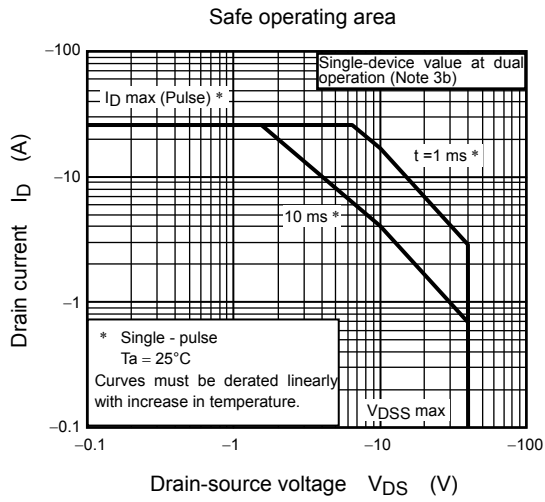
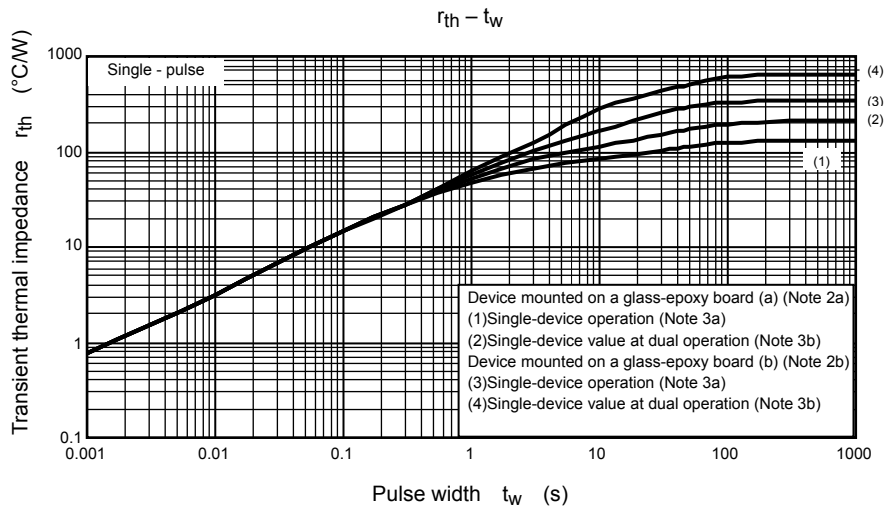
**P-Channel**



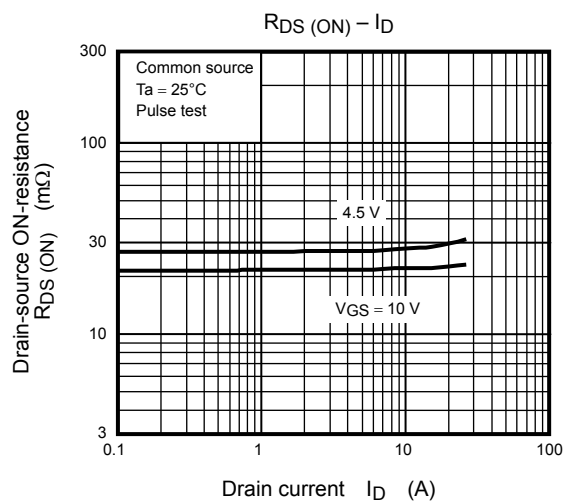
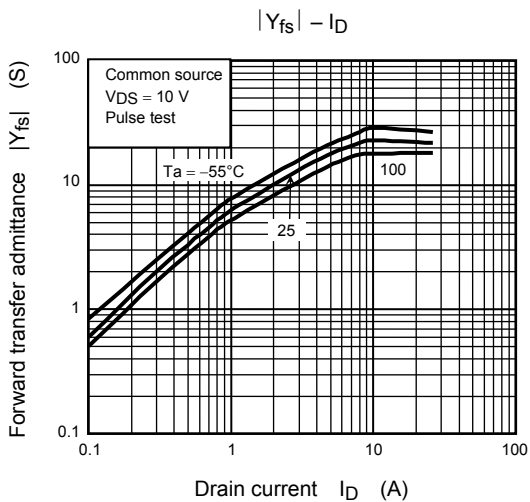
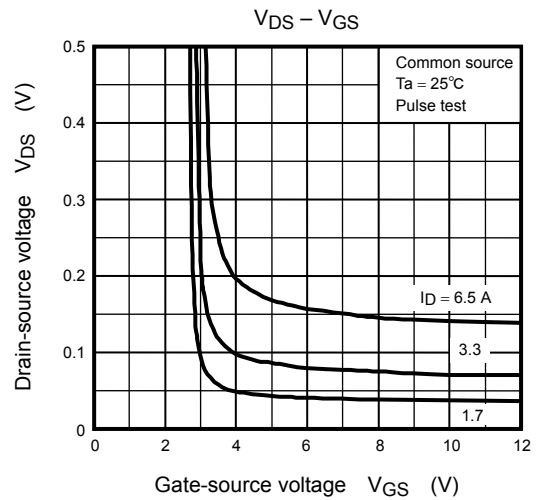
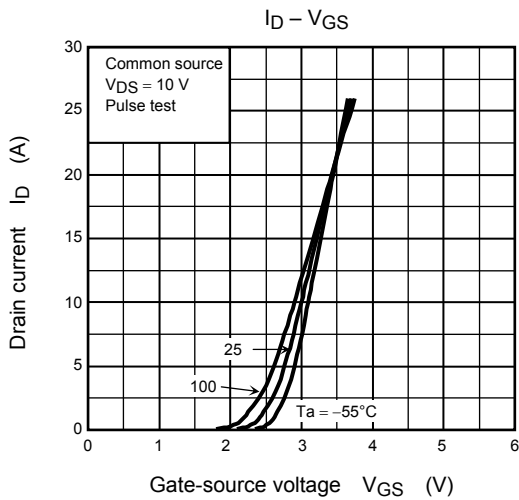
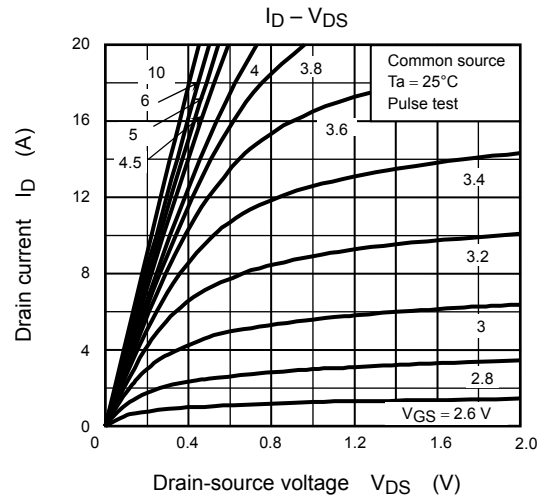
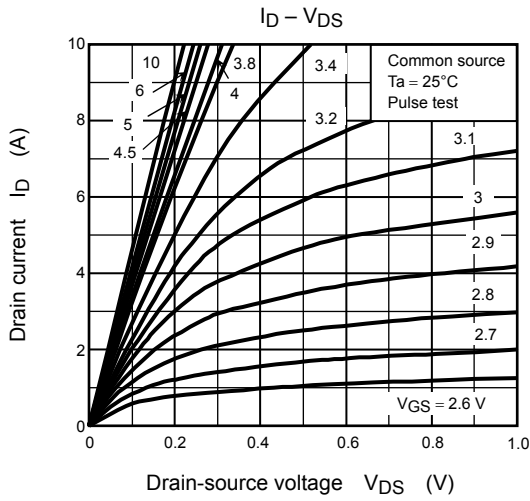
## P-Channel



## P-Channel

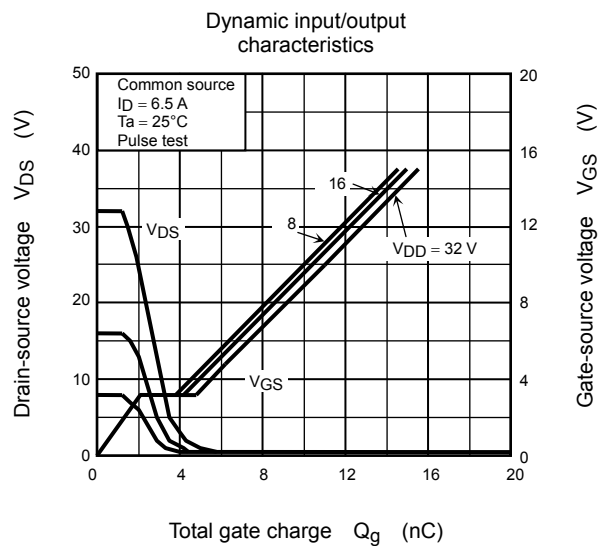
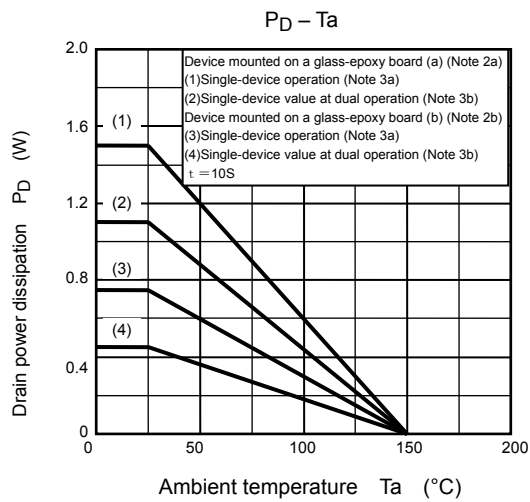
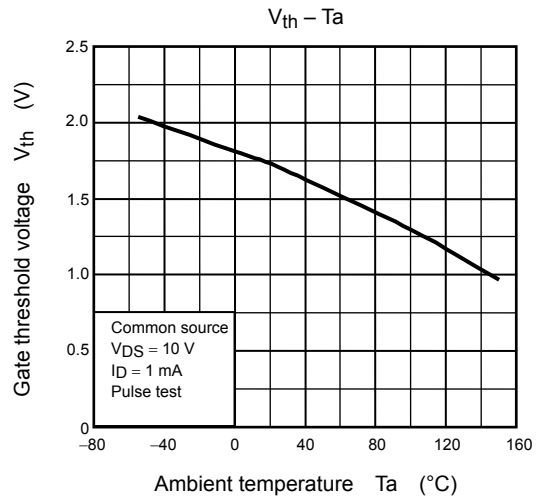
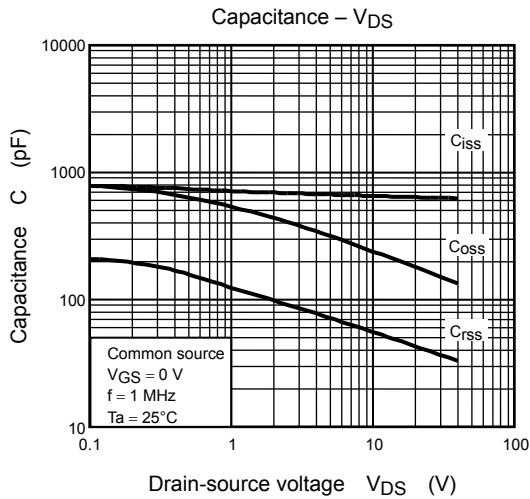
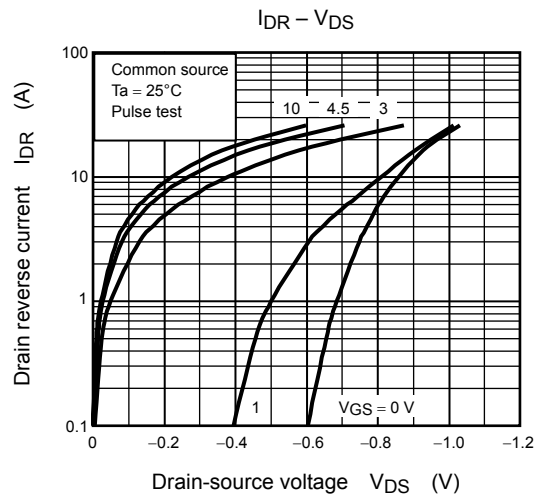
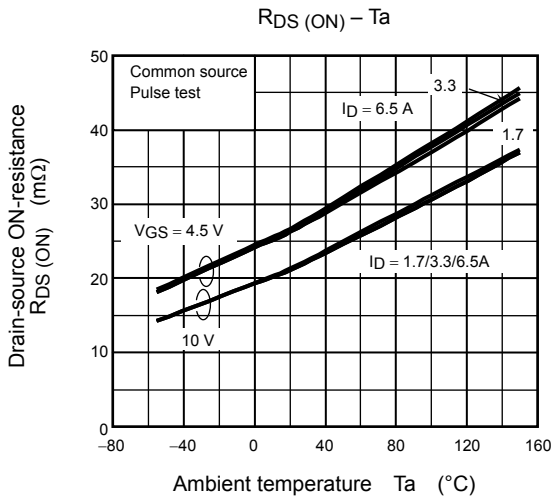


**N-Channel**

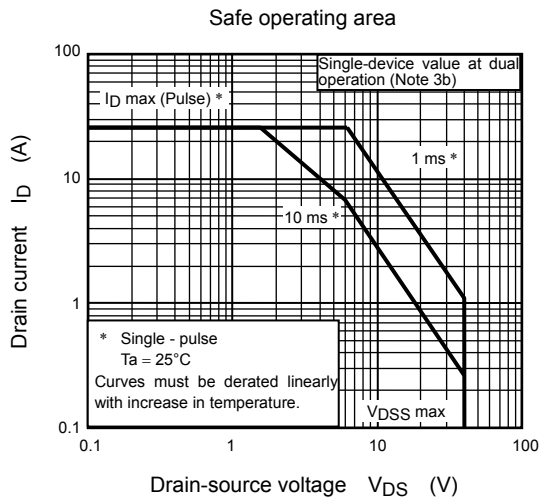
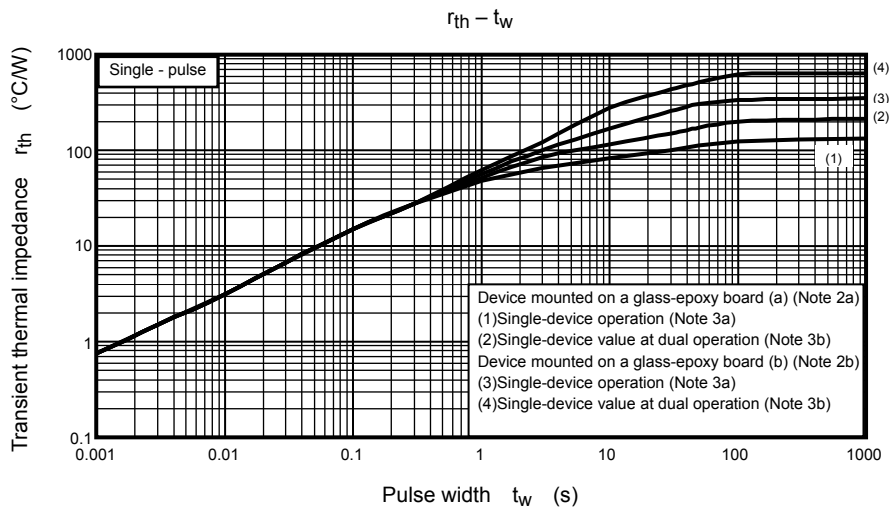




N-Channel



## N-Channel



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